University of Bahrain
College of Information Technology
Department of Computer Science
ITCS 312 Formal Languages & Automata Theory
1st Semester 2004-5
Final Examination

Time: 2 Hrs **Max. Marks:58**

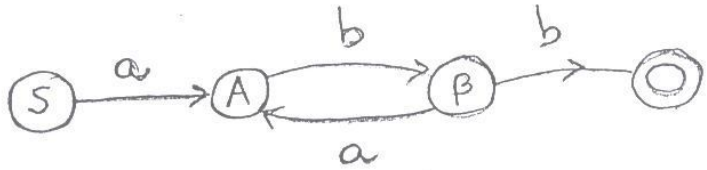
Q 1. (10 marks)

a) Given a dfa M = (Q, Σ, δ, q_0, F), define δ: ------ → ------- and L(M) = { ------ }
b) Given an nfa M = (Q, Σ, δ, q_0, F), define δ: ------ → ------- and L(M) = { -----}
c) Given an npda M = (Q, Σ, Γ, δ, q_0, Z, F), define δ: ------ → ------- , L(M) = { ----------} and Instantaneous Description.
d) Given a TM M = (Q, Σ, Γ, δ, q_0, □, F), define δ: ------ → ------- , L(M) = { ----------} and Instantaneous Description
e) Given G =(V,T, S, P), define L(G) = {----------}

Q 2. (8 marks) For each of the following, determine whether 'True' or 'False'. Give reasons.

a) Given an nfa to accept a language L, it is not possible to accept Σ* - L using the same nfa with the final and non-final states interchanged.
b) For L = { ω ε Σ* : $n_a(\omega) = n_b(\omega)$, where Σ ={a, b}}, L= L^+?
c) The grammar S →aSa | bSb| λ generates L(G) = {ωω^R : ω ε {a, b}*}
d) (ϕ*)* denotes empty Language.

Q 3. (18 marks) Consider the following nfa.



Find

a) An equivalent dfa
b) Language accepted by the nfa.
c) Regular expression to denote the language.
d) Right linear grammar to generate the language.
e) Left linear grammar to generate the language.
f) An npda to accept the language.

Q 4. (6 marks) For each of the following, write 'True' or 'False'. Give reasons.

Language	Recognized by		
	dfa	npda	TM
$\{a^n b^m c^p : n, m, p \geq 1$			
$\{a^n b^n c^p : n, p \geq 1$			
$\{a^n b^n c^n : n \geq 1$			

Q 5. (6 marks)

a) Draw a derivation tree of $S \rightarrow aSa \mid bSb \mid \lambda$ for ω = aabbaa. Is the grammar ambiguous? why?

b) An ID and transition function δ for TM is given as:
$ababq_2cab$; $\delta(q_2, c) = (q_1, c, L)$; $\delta(q_1, b) = (q_2, b, R)$
Find the state in which the machine will halt.

Q 6. (6 marks) Given the grammar

$S \rightarrow DC$
$S \rightarrow aDb \mid A$
$A \rightarrow aA \mid a$
$B \rightarrow bB \mid b \mid \lambda$
$C \rightarrow cC \mid \lambda$

Remove all λ-, unit-, and useless- productions.

Q 7. (4 marks) Find an npda to accept $L = \{a^n b^m b^m a^n : n \geq 1, m \geq 1\}$.

Q 8. (6 marks) For each of the following, find a dfa and a grammar with $\Sigma = \{a, b\}$ for

a) Language having all strings with no more than two a's.
b) $L = \{\omega : |\omega| \bmod 3 \neq |\omega| \bmod 2\}$